Microsoft

Broadband mapping meetings

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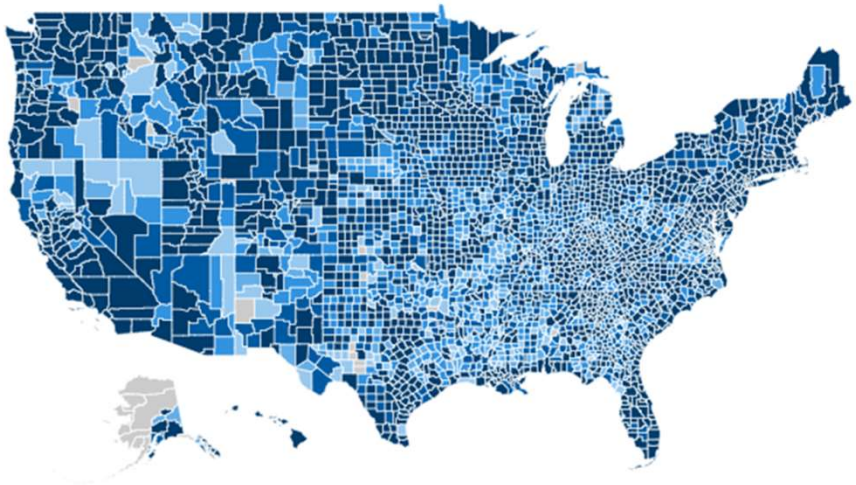
Agenda

- Review FCC broadband availability and broadband usage based Microsoft data.
- Discuss using FCC Subscription data, Microsoft Usage data, and other 3rd party public data to help judge broadband progress and identify future investments.
- Explore the definition of “broadband availability” and any steps we can jointly take to define “broadband availability” from a consumer perspective
- Present outlier zip code analysis
- Impact broadband has on GDP and Jobs
- Review wired vs wireless technology adoption curves

Broadband availability based on FCC Form 477 data

- 2019 FCC Broadband report states broadband is available to ~93.5% of people in the United States
- ~21.3M people do not have access to broadband

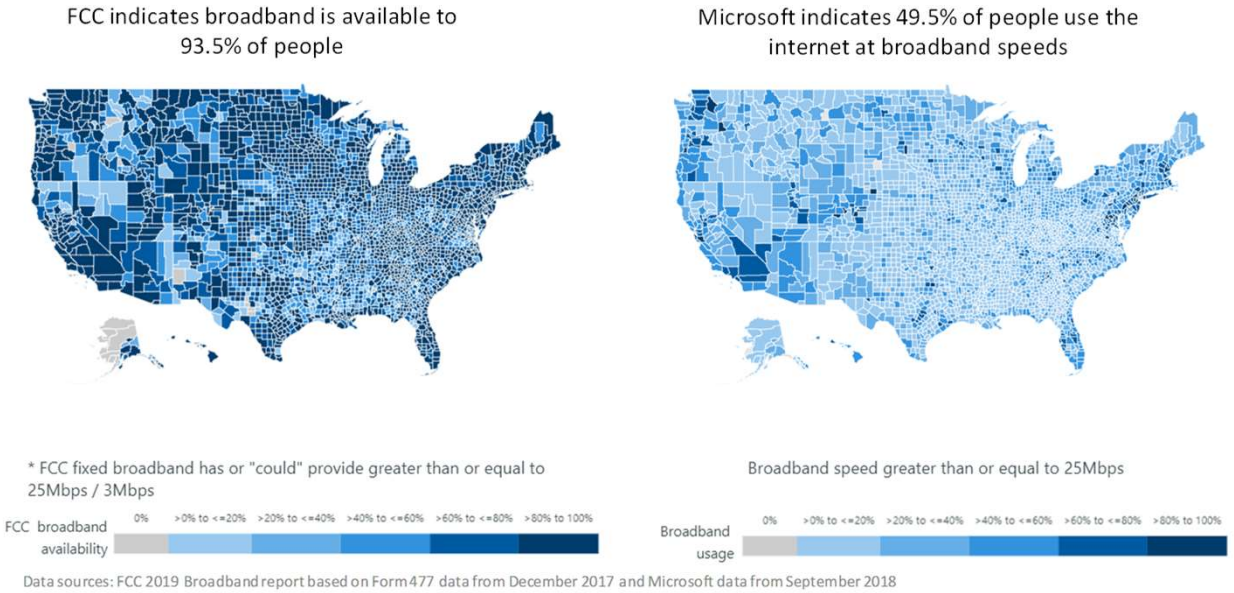


* FCC fixed broadband has or "could" provide greater than or equal to 25Mbps / 3Mbps

Data sources: FCC 2019 Broadband report based on Form 477 data from December 2017 and Microsoft data from September 2018

Broadband usage based on Microsoft data

- FCC reports 93.5% of the country has access to fixed broadband at a minimum of 25 Mbps/3Mbps; Microsoft estimates ~49% of people access the internet at broadband speeds
  - Availability does not equal usage; however usage gives us the ground truth in the progress we are making in broadband adoption.
  - Through artificial intelligence and machine learning models using device level (no PII) data (over 200+ Microsoft services) we estimate download speeds and broadband coverage
  - We make a very minor adjustment in areas of the country that Microsoft may not have a presence with third party data i.e. ComScore



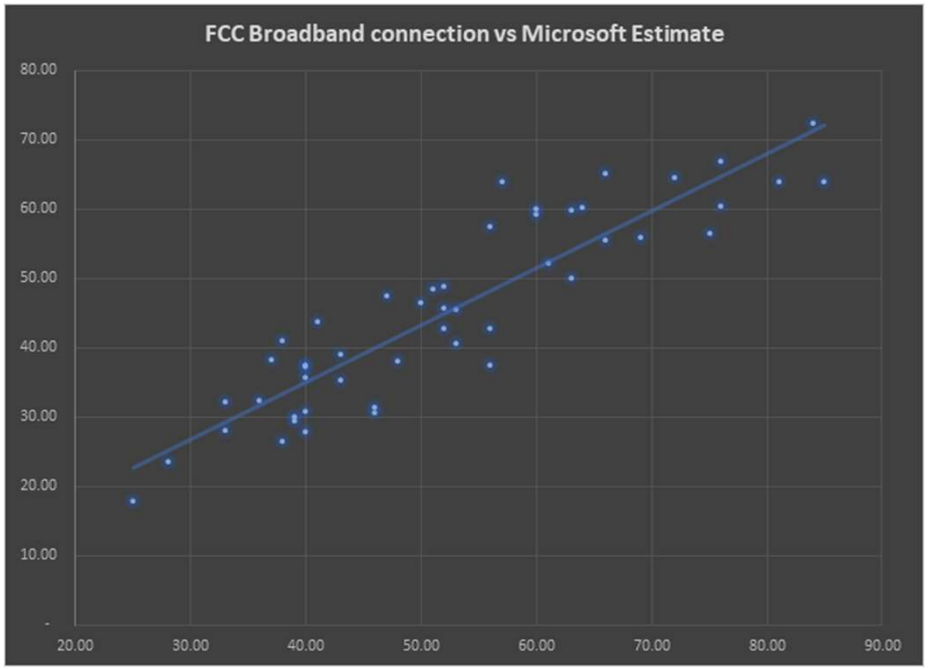
Use FCC Subscription data, Microsoft Usage data, and other 3rd party public data to show a more transparent view of today's actual gaps in broadband progress.

- There is a ~90% correlation between the ISP self stated "usage" data known as "Connection data" and broadband usage based on Microsoft data.

Figure 32 - Continued
Residential Fixed Connections and Households by State as of June 30, 2017
(Connections and households, in thousands)

State	Households	At least 200 kbps in at least One Direction		At least 10 Mbps Down and 1 Mbps Up		At least 25 Mbps Down and 3 Mbps Up		At least 100 Mbps Down and 10 Mbps Up	
		Connections	Subscribership Ratio	Connections	Subscribership Ratio	Connections	Subscribership Ratio	Connections	Subscribership Ratio
Nevada	1,031	891	0.86	740	0.72	580	0.56	*	*
New Hampshire	521	484	0.93	414	0.79	373	0.72	135	0.26
New Jersey	3,195	2,945	0.92	2,792	0.87	2,696	0.84	1,076	0.34
New Mexico	763	548	0.72	332	0.43	288	0.38	80	0.10
New York	7,266	6,189	0.85	5,726	0.79	5,038	0.69	2,076	0.29
North Carolina	3,815	3,062	0.80	2,369	0.62	1,981	0.52	1,108	0.29
North Dakota	305	246	0.81	215	0.70	172	0.56	31	0.10
Northern Mariana Isl	16	*	*	*	*	*	*	0	0.00
Ohio	4,601	3,573	0.78	2,880	0.63	1,764	0.38	277	0.06
Oklahoma	1,462	1,014	0.69	741	0.51	477	0.33	140	0.10
Oregon	1,546	1,304	0.84	1,045	0.68	922	0.60	265	0.17
Pennsylvania	4,962	4,031	0.81	3,397	0.68	3,010	0.61	1,155	0.23
Puerto Rico	1,237	*	*	*	*	*	*	*	*
Rhode Island	410	363	0.88	349	0.85	314	0.76	*	*
South Carolina	1,839	1,436	0.78	1,181	0.64	731	0.40	100	0.05
South Dakota	334	259	0.78	220	0.66	188	0.56	17	0.05
Tennessee	2,522	1,865	0.74	1,576	0.62	1,207	0.48	292	0.12
Texas	9,290	7,320	0.79	6,131	0.66	4,368	0.47	2,072	0.22
Utah	918	792	0.86	601	0.65	525	0.57	214	0.23
Vermont	257	242	0.94	171	0.67	135	0.53	53	0.21
Virgin Islands	43	27	0.62	*	*	*	*	*	*
Virginia	3,090	2,534	0.82	2,204	0.71	1,967	0.64	708	0.23
Washington	2,697	2,390	0.89	1,950	0.72	1,786	0.66	682	0.25
West Virginia	739	530	0.72	373	0.50	296	0.40	72	0.10
Wisconsin	2,310	1,820	0.79	1,435	0.62	950	0.41	27	0.01
Wyoming	227	177	0.78	128	0.57	105	0.46	1	0.00
Total	119,064	97,071	0.82	80,671	0.68	64,520	0.54	21,774	0.18

= Rounds to Zero; * = Data withheld to maintain firm confidentiality.
Note: Figures may not sum to totals due to rounding.
Sources: FCC Form 477 (Connections); 2012-2016 5-year estimates; Census 2010.



Explore the definition of broadband availability

- What does "broadband" mean to the consumer?
  - FCC definition is 25Mbps down and 3 Mbps up
- What does it mean to have broadband "available" to the consumer?
  - Quality, Cost, and Time

Pew Research
65% of U.S. adults who are home broadband users (01/18/18)

Per Pew Research article in August 2013 "Our broadband question has historically tried to distinguish between dial-up users and those with higher connection speeds."

Phone survey question: "At home, do you connect to the Internet through a dial-up telephone line, or do you have some other type of connection, such as a DSL-enabled phone line, a cable TV modem, a wireless connection, or a fiber optic connection such as FIOS

American Fact Finder
67% of households with broadband subscriptions (2013-2017)

An Internet "subscription" refers to a type of service that someone pays for to access the Internet such as a cellular data plan, broadband such as cable, fiber optic or DSL, or other type of service. This will normally refer to a service that someone is billed for directly for Internet alone or sometimes as part of a bundle

Broadband such as cable, fiber optic, or DSL

FCC
54% subscription ratio of residential fixed connections and households at least 25Mbps down and 3Mbps up

Form 477 Fixed Broadband Subscription June 0217
Report the total number of in-service connections—and report the number of in-service connections that are in consumer service plans—for each unique combination of census tract and service characteristic.

Broadband connections are wired "lines" or wireless "channels" that enable the end user to receive information from and/or send information to the Internet at information transfer rates exceeding 200 kbps in at least one direction

Objective of the outlier zip code analysis

- Hypothesis: If we can find zip codes with inaccuracies in availability data in an automated way using machine learning this could help the FCC (given their stated limited resources to inspect and enforce potential inaccuracies) and ISPs (to correct data inaccuracies).

- Utilizing further machine learning to predict availability, we have created a model to identify a subset of zip codes that MAY have inaccuracies.

- There is no guarantee that these zip codes are being reported inaccurately; however based on using a machine learning model and additional validation with a third-party survey done by Broadbandnow, we recommend that the FCC uses this as a short list to inspect potential inaccuracies.

- Our plan is to make the model publicly available on GitHub and the output publicly available in the near future.

Top 20 potential outlier zip codes

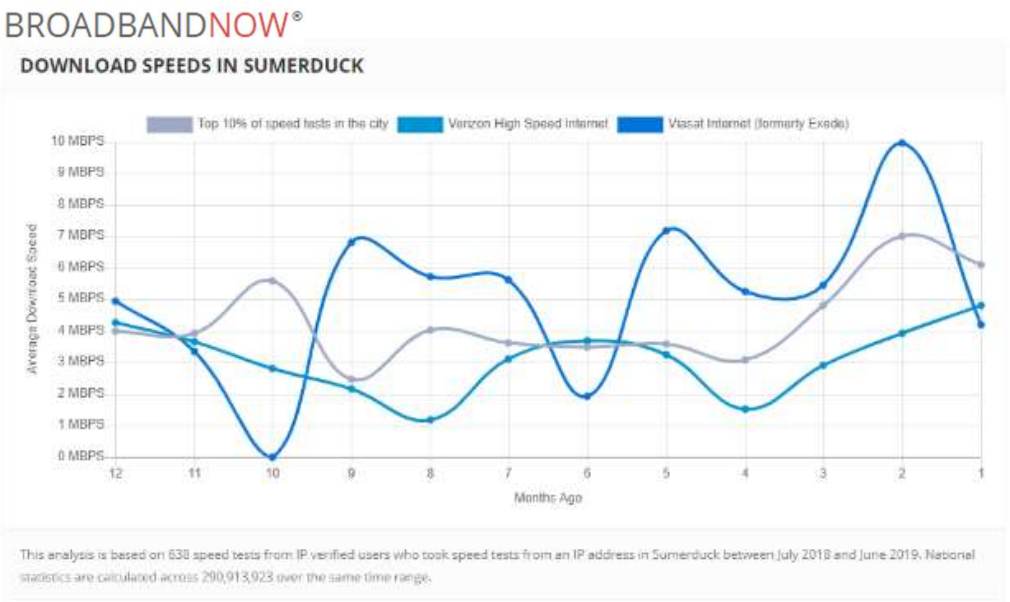
- List of the top 20 potential outlier zip codes sorted by the largest difference in reported FCC availability and Microsoft ML predicted availability out of a longer list we are reviewing.

State	Zip code	FCC broadband availability 2019 report	Usage Feb 2019
PA	17949	91.8%	0.0%
VA	22742	100.0%	0.5%
WV	26386	100.0%	9.5%
FL	33890	94.0%	4.7%
OH	44076	92.1%	5.9%
OH	45856	98.3%	4.5%
IA	50514	98.0%	4.5%
MN	56282	100.0%	3.7%
KS	66079	100.0%	0.6%
AR	71956	97.3%	6.1%
AR	71968	99.1%	7.7%
OK	74332	99.9%	0.7%
TX	78118	100.0%	3.4%
TX	78151	99.6%	0.5%
TX	78941	99.5%	2.8%
CA	93602	93.7%	8.5%
CA	95638	100.0%	2.2%
OR	97456	94.7%	7.6%
WA	98855	97.9%	7.4%
WA	99122	100.0%	4.0%

Zip code: 22742 in Virginia

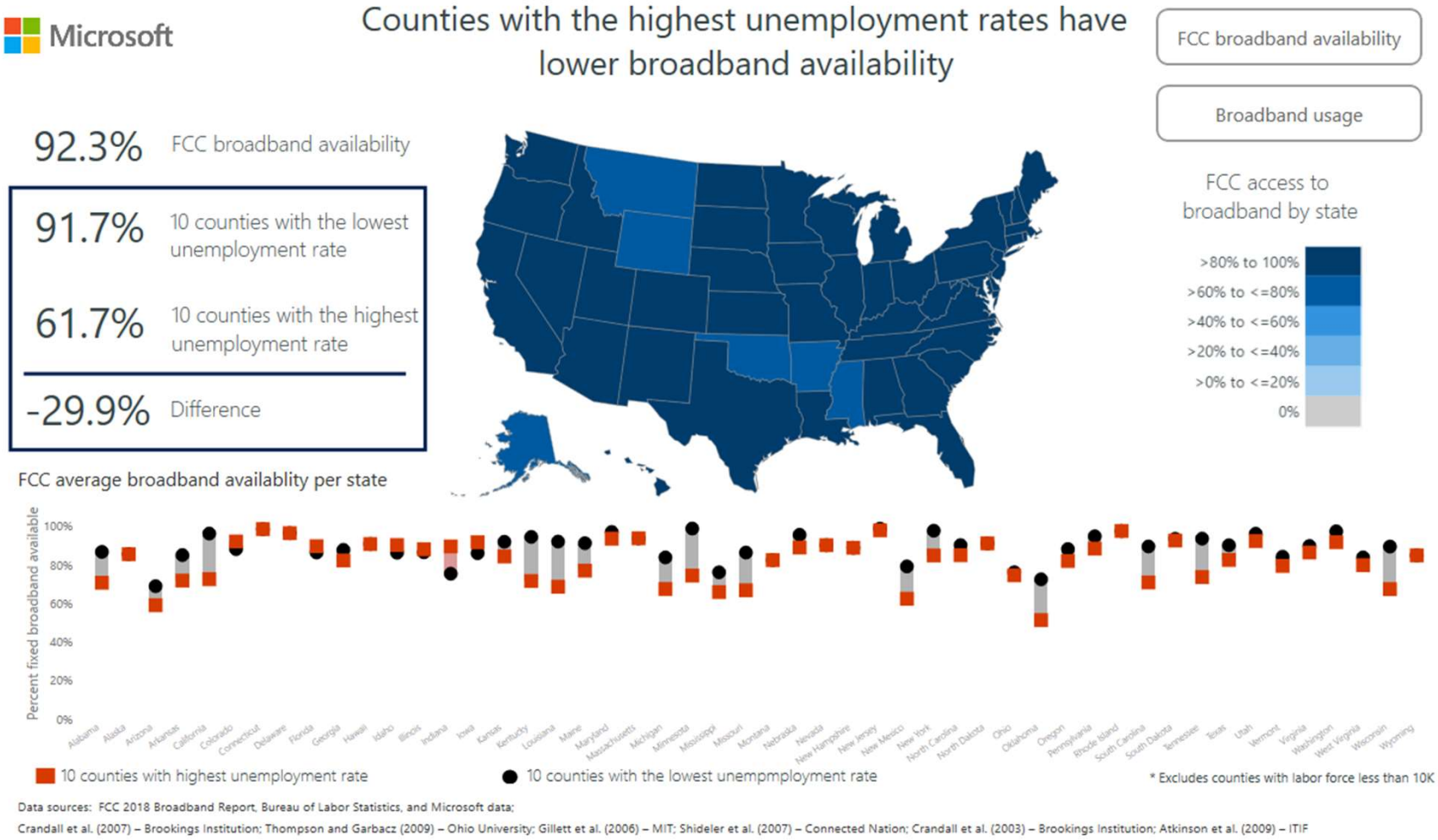
Estimated FCC broadband availability* (2019 report)	Estimated percent of people using the internet at broadband speeds	Gap
100.0%	0.5%	99.5

* *zip codes may contain portions of multiple census tracts*



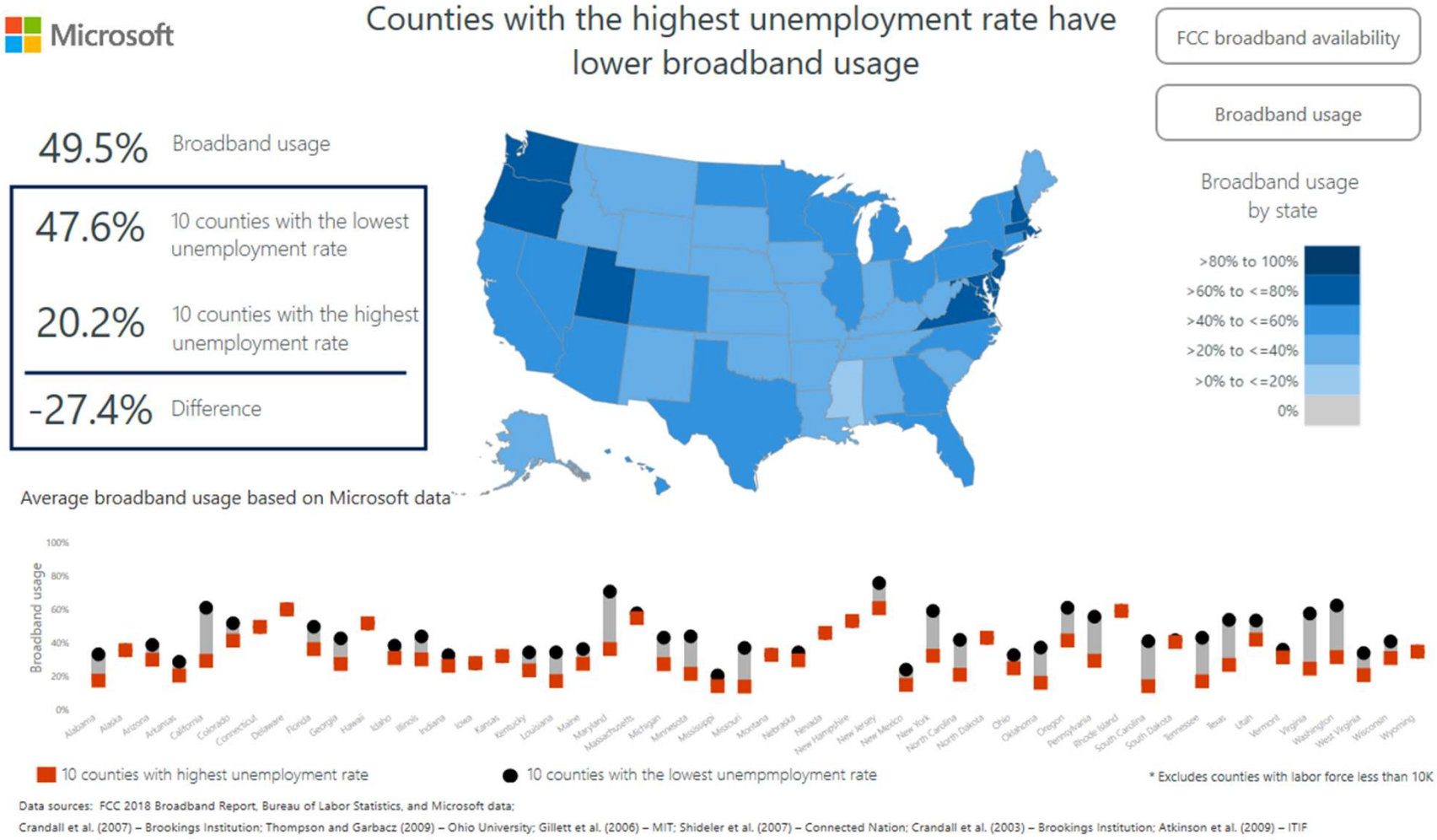
Source: FCC 2019 broadband report, Microsoft data, and broadbandnow.com

Broadband is less available in counties with high unemployment compared to counties with lower unemployment



Data sources: FCC 2018 Broadband Report, Bureau of Labor Statistics, and Microsoft data;
Crandall et al. (2007) – Brookings Institution; Thompson and Garbacz (2009) – Ohio University; Gillett et al. (2006) – MIT; Shideler et al. (2007) – Connected Nation; Crandall et al. (2003) – Brookings Institution; Atkinson et al. (2009) – ITIF

Similar to broadband availability, usage is lower in counties with high unemployment compared to counties with lower unemployment



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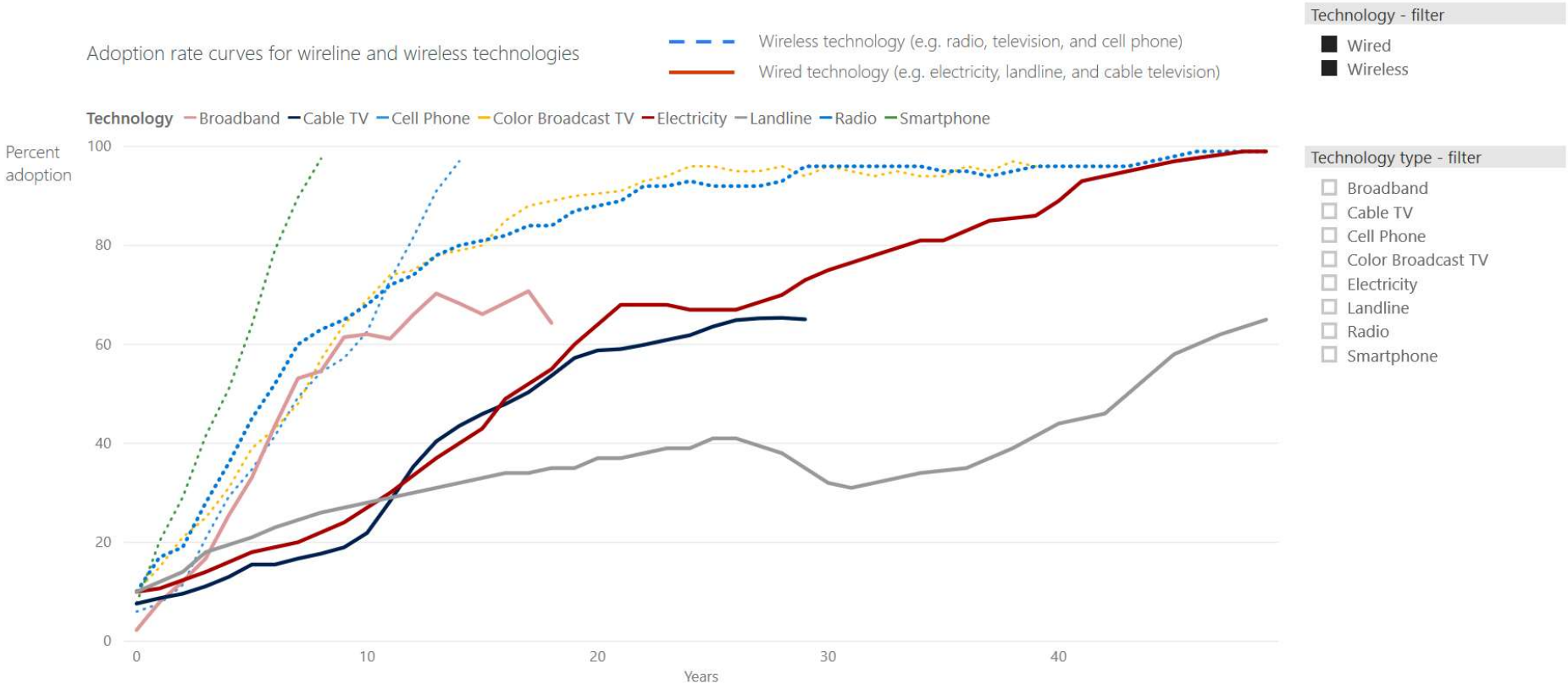
Wireless technology adoption occurs at a much faster rate than wired technologies



Data sources: Technology Diffusion (Comin and Hobijn (2004) and others)

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